ON A SMALL COLLECTION OF VERTEBRATE FOSSILS FROM THE LOUP FORK BEDS OF NORTHWESTERN NEBRASKA; WITH NOTE ON THE GEOLOGY OF THE REGION.

By J. B. Hatcher.[1]

The Princeton Scientific Expedition of 1893, besides securing a quite complete series of fossils from the Protoceras beds of the upper White River, was also fortunate in securing small, but interesting collections from the Loup Fork and overlying Equus beds, and in discovering unconformities between the latter. These unconformities made it possible to distinguish sharply between the top of the Loup Fork and the base of the Equus beds; and consequently to separate the fossils of the one from those of the other with certainty.

The work in the Loup Fork and Equus beds was done by the writer previous to the arrival of the other members of the expedition. The material collected was found in the adjacent hills on the south side of the Niobrara river, midway between the mouths of Pine and Box Butte creeks in Sheridan Co., Nebraska. The material from the Loup Fork beds has been placed in my hands for description through the kindness of Prof. W. B. Scott, under whose direction the expedition was undertaken. It contains, besides several species already fully described from these beds, the following material representing one new genus, and three new species and presenting interesting characters not before noticed in species already known.

AELURODON TAXOIDES, sp. n.

Among the Loup Fork Carnivora, the genus Aelurodon was predominant, both as to individuals and species represented. In size they were propably only equalled among the Carnivora of this epoch by the sabre-toothed cats. In the latter they doubtless found formidable enemies.

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The type of this species consists of a very complete and well preserved left mandibular ramus. It belonged to an animal about the size of the black bear. The mandible is long and proportionately slender. Posterior depth but little greater than anterior. Masseteric fossa very deep, its anterior border ending directly below the third molar. Anterior mental foramen directly below middle of second premolar. Posterior mental foramen directly below posterior root of third premolar. Surface between anterior margin of masseteric fossa and a point below the middle of the sectorial quite concave. Inferior border nearly straight from synphysis to a point directly beneath the posterior border of the second molar, when it rises quite rapidly to the angle, much as in the badger (*Meles taxus*) thus suggesting the specific name. The angle is considerably expanded transversely for the attachment of the masseter muscle. The exterior border of this expansion is on a line with the base of the teeth. The condyle is strong. The coronoid process is quite high and proportionately somewhat slender. Its upper and anterior borders, especially the latter, are considerably expanded transversely to give greater surface for the attachment of the temporal muscle. The inner border of the ramus is a nearly plane surface, except anteriorly where it is strongly convex. The dental foramen is situated about midway between molar three and the angle, and is on a line with the alveolar border. The symphysis is small and triangular in outline, and is extended somewhat below the inferior border of the jaw. Its supero-inferior diameter is about twice that of the antero-posterior diameter.

The Teeth: The incisors are missing, but they are represented by three somewhat shallow alveoli crowded closely together. The internal and middle incisors were about equal in size and quite small. The latter was crowded considerably backward out of line with the external and internal. The external incisor was considerably larger than incisors one and two. The canine is only moderately strong and is oval in cross-section at the base. The first premolar is missing, but the alveole is well preserved and shows it to have been of moderate size and fixed by one root only. There is a diastema between it and

the canine and a shorter one between it and premolar two. Premolars two, three, and four are strong, well developed teeth, they increase regularly in size and are separated by diastemata. The sectorial is large as compared with molars two and three, its antero-posterior diameter being almost double that of both these teeth taken together. The metaconid is exceedingly faint, the talon is low and flat and consists of both an external and internal cone of which the former alone has been subjected to wear. Molar two is quite small, not so large as premolar two. Molar three is missing but the alveole shows it to have been quite rudimentary and implanted by one root only in the slightly rising alveolar border of the jaw.

The present species appears to be most closely related to *A. uirsinus* Cope and *A. haydenii* Leidy. From the former it is readily distinguished by the nearly uniform depth of the jaw, by the much smaller canine and by the relative and absolute size of the premolar and tubercular teeth. In *A. ursinus* according to Cope[2] the first tubercular considerably exceeds in size the fourth premolar, in *A. taxoides* the fourth premolar is twice the size of the first tubercular. From *A. haydenii* it is at once distinguished by the much less elevated posterior portion of the alveolus, by the somewhat less massive appearance of the jaw and by the diastemata between the premolars. The following are the more important measurements of the type specimen.

	M.
Length of jaw from front of synphysis to middle of condyle	.207
Length of premolar dentition	.062
Length of molar dentition	.053
Antero-posterior diameter of sectorial	.034
Antero-posterior diameter of first tubercular	.012
Antero-posterior diameter of fourth premolar	.022
Depth of ramus below first premolar	.039
Depth of ramus below first tubercular	.040

In Plate I, figures 2 and 2[a] represent the side and crown views of the type and show well the more important charac-

[2]See U. S. Geogr. S., G. M. Wheeler, part II, Vol. IV, p. 304, 1877.

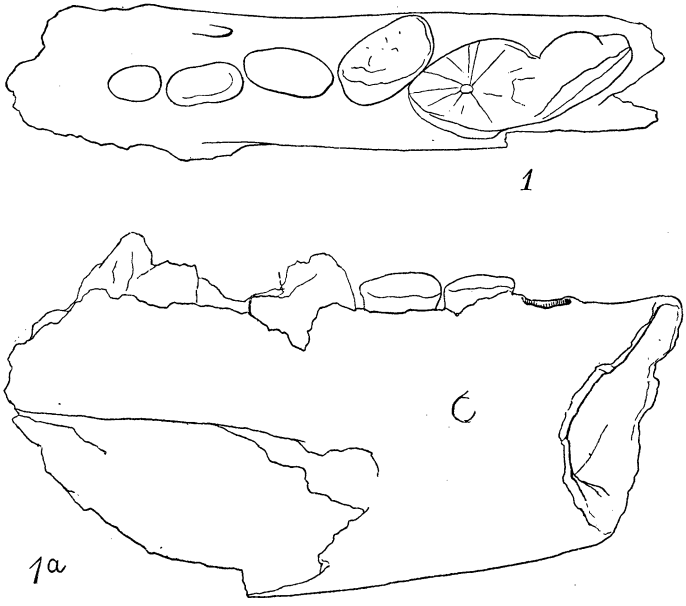
ters. An atlas vertebra found in connection with the type specimen shows a distinct foramen for the inferior branch of the first spinal nerve, but presents no other distinctive characters.

AELURODON MEANDRINUS, sp. n.

This species is by far the largest of the genus yet described. The type consists of the right mandibular ramus, broken off at the canine and just back of the sectorial. It indicates an animal about the size of the grizzly bear. The jaw was exceedingly strong and massive in proportion to its length. The crowns of premolars two and three are preserved and the roots of the sectorial and premolar four. The symphysis is quadrangular in shape and extends backward to below the middle of premolar three, its upper border approaches very closely the alveolar border. The anterior mental foramen is large and is situated just below the posterior root of premolar two. The arrangement of the teeth is especially characteristic and has suggested the specific name. . The second, third, and fourth premolars are implanted in the the jaw in a zig-zag manner. The anterior end of premolar three is entirely outside of the posterior root of premolar two. Premolar four is set quite as much transversely as longitudinally in the jaw, its posterior root being as much outside of as behind the anterior. The anterior root of the sectorial is inside of and overlaps the posterior root of premolar four. This arrangement of the teeth is well shown in figs. 1 and 1ª.

The canine was very large as indicated by the alveole which is partially preserved. There was a long diastema between it and premolar one. The latter tooth was small and fixed by one root only. Premolars two and three are small and nearly equal in size. Premolar four is much larger than two and three. All the premolars are separated by very small diastemata. The sectorial is exceedingly large, its antero-posterior diameter equalling in length the space occupied by premolars two, three, and four. In fig. 1 only about half the posterior root of the sectorial is shown, thus making the tooth appear shorter than it really is. The following are the principal measurements of the type.

	M.
Length of premolar dentition	.060
Antero-posterior diameter of sectorial	.047
Length of diastema between canine and P. 1.	.019
Depth of ramus below P. 1.	.050
Depth of ramus just behind P. 4.	.055



APHELOPS, Cope.

Cope has defined the genus Aphelops as follows.[3] Dentition: I $?\frac{2-1}{1}$, C $\frac{1}{1}$, P $\frac{4-3}{3}$, M $\frac{3}{3}$; post-glenoid and post-tympanic process in contact but not coossified; digits 3–3; nasals hornless. To these characters Osborn[4] has added: "Magnum not supporting lunar anteriorly; absence of the crista and invariable presence of the more or less strongly developed 'crochet' and 'anticrochet' in the superior molars." The projection referred to by Prof. Osborn as the anticrochet is, I think, really the crista, since it is produced quite as much or more from the

[3]Bull. V, U. S. G. S.. 1879–80.

[4]Bull. Mus. Comp. Zool. Harvard, p. 92.

upper border as from the lateral, and moreover, an examination of material in our collection shows in molar one of Aphelops and molor two of Teleoceras an additional small projection directly opposite the large anticrochet, and which I believe to be the crochet and have so lettered it. See Plate II, figs. 5 & 6. I would therefore amend Prof. Osborn's dental characters to read as follows: Invariable presence of strong anticrochet and crista and absence of well defined crochet on superior molars. If this projection is not the crista, it is the crochet instead of the anticrochet, as considered by Osborn.

APHELOPS FOSSIGER, Cope.

I have referred a nearly complete skull in our collection to the above species. It differs from Cope's definition of that species however by the following characters which may perhaps be considered of specific importance. In molar one the the median sinus is obstructed by a large crista and anticrochet and a very small crochet, in molar two there is no trace of a crochet and at the bottom of the entrance of the median sinus there is a small tubercle. In molar three at the bottom of the entrance of the median sinus, there is an elongated tubercle placed transversely, and just inside this is a second much smaller conical tubercle. At about the middle and on the upper border of the zygomata there are processes curving inward and downward which probably served as attachments for the zygomatico-auricularis muscles. The molar teeth also are extremely large. Below are some of the measurements.

	M.
Length of true molars	.168
Median length of second molar	.062
Greatest length of second molar	.075
Greatest width of second molar	.077

TELEOCERAS MAJOR, Hatcher.

As stated in a preliminary notice,[5] this genus is distinguished from all previously known genera of the *Rhinocerida* by

[5]Am. Geol., March, 1894, pp. 149–150.

the presence of a median horn on the extremities of the nasals, the presence of a sagittal crest? as indicated by the contour of the outer walls below this region and the presence of a strong anticrochet and crista and the absence of a well developed crochet on the superior true molars.

The type consists of a portion of the skull and lower jaw. The superior and inferior molars are preserved and also the fourth upper premolar. The skull is long and proportionately much deeper and narrower than in the closely allied genus Aphelops. The nasals are only partially coossified, they are very thick and strong, much compressed anteriorly and strongly convex superiorly. Their extremities are prolonged into a short, stout horn which extends about an inch beyond the extremities of the nasals proper, and is directed upward and forward, it is slightly constricted inferiorly just in front of the termination of the nasals; it is rugose and in life evidently supported a dermal horn. These characters are well shown in Plate I, figs. 1, 1^b, 1^c, 1^a. The frontals are comparatively narrow and smooth, and their upper transverse surface is gently convex, they are elevated posteriorly so that the median line from the posterior portion of the frontals to the end of the nasal horn is slightly concave. The infra-orbital foramen is large, opens anteriorly and not laterally directly over the middle of premolar three. The maxillaries are large, strong and deep. The anterior border of the posterior nares is on a line with the posterior border of the median sinus of molar two, there is no median projection. The temporal region is much constricted, the inferior lateral walls of the brain case in this region are exceedingly thin, there were no air cavities in this region of the skull. The base of the skull sloped upward and forward from the condyles which are missing. The post-glenoid process is strong and triangular in cross-section, it is confluent *but not coossified* with the post-tympanic throughout the greater portion of their length, thus entirely enclosing the *meatus auditorius externus.*

The lower jaw is exceedingly strong and massive. The ascending portion is very high and broad with the posterior border but slightly expanded transversely. The masseteric

fossa is very shallow. The inferior dental foramen is large. The coronoid process is wide at the base and narrows rapidly toward the apex. The angle is produced but slightly downward. The inferior border is gently convex.

The Teeth: Of the superior dentition the true molars and the fourth upper premolar alone are represented. They are larger than in the recent rhinoceros but much smaller than in *Aphelops* as shown in Plate II, figs. 5, 6, & 9. Molars two and three are best preserved and present the most distinctive characters. The dorsum is very flat, there is no median costa and the anterior and posterior costae are only faintly represented On the posterior angle of molar three there is a well developed basal cingulum. The median sinus of this tooth is obstructed by a well developed anticrochet and crista. At the bottom and near the entrance of the median sinus is a small tubercle. Molar two has a faint crochet directly opposite the strong anticrochet and a well developed crista as shown in Plate II, fig. 6. There was a deep posterior sinus with a strong posterior vallum which in the type has been worn down so that the posterior sinus now appears as a posterior fossette. There is a very small anterior sinus and the anterior vallum is weak. In molar one and premolar four the teeth are so much worn that the anterior and posterior cross-crests are united through the anticrochet, and the inner portion of the median sinus appears as an accessory fossette.

In the inferior dentition the last molar is placed well in front of the ascending portion of the ramus, it is but little larger than molars one and two, and has a basal cingulum on the posterior border. The following are the principal measurements of the skull, lower jaw, and teeth.

SKULL AND SUPERIOR DENTITION.

	M.
Length of skull from end of nasal horn to behind post-tympanic process	.585
Depth of skull from middle of frontals to crown of teeth	.235
Width of skull in front of zygoma	.210

Length of horn beyond termination of nasals	.028
Diameter of horn	.041
Length of molar dentition	.158
Greatest transverse diameter of molar two	.069
Greatest antero-posterior diameter of molar two	.055

LOWER JAW AND TEETH.

	M.
Length of ramus from anterior border of premolar four to posterior border	.420
Height from bottom of angle to condyle	.260
Depth below molar three	.109
Length of molar dentition	.155
Length of molar two	.054
Length of molar three	.058

Teleoceras although presenting several characters apparently intermediate between Aphelops and existing genera of Rhinoceridæ, nevertheless cannot be considered as an ancestor of the latter. Neither is it a migrant from Europe. It is really a horned Aphelops derived perhaps through Leidy's species *A. crassus;* which latter is not unlikely to be identical with *A. fossiger* (Cope) and *A. acutum* (Marsh), all of which have been described as possessing compressed, acuminate nasals, thus suggesting a horn at the very place where it appears in *Teleoceras.*

The discovery of a *median horned Rhinoceras* in America is of interest not as a probable ancestor of existing Old World forms, but rather as exhibiting a remarkable example of *parallelism* in the development of the Old and New World species of Rhinoceridæ from their common ancestral genus Aceratherium of the lower Miocene of this continent. Our present knowledge would indicate, as has been pointed out by Scott,[6] that the ancestral type originated in America and found its way into the Old World in early Miocene times. The genus Aceratherium which flourished during the lower Miocene was common to both continents, and all the median horned

[6]See Bull. 3, E. M. Museum, Princ. Coll., pp. 1–22, 1883.

and hornless forms of each continent may reasonably be considered to have been developed independently from it. There seems at present no evidence for supposing that there was any interchange of species between the two continents later than early Miocene times. This degree of parallelism is all the more striking when we consider the length of the period of isolation in connection with the marked degree of similarity shown. This similarity is exhibited not only in the development of a nasal horn, but also in the general appearance of the skull, the complexity of the structure of the teeth and their arrangement in the jaw, and the relations of the post-tympanic and post-glenoid processes, Figs. I–4, Plate II, show the latter in the genera Rhinoceros, Teleoceras, Aphelops and Ceratorhinus. On the same plate, figs. 5, 6, 7, 8 & 9 represent various stages of tooth development from Aceratherium to Teleoceras and recent forms. As regards specialization of parts and complexity of tooth structure, from what is at present known of Teleoceras, it may be regarded as equalling in these respects any of our recent forms. If we compare it with *Rhinoceros sansaniensis* (Lartet) from a horizon in France of which our Loup Fork has been considered an equivalent, it will at once be seen that the tooth structure of the latter is much simpler and more like Aceratherium. See Plate II, fig. 7 (after Filhol). If these beds be really of the same age we must conclude that the conditions favorable for the development of the more modern types of the Rhinoceridæ, existed to a much greater degree in America than in Europe, a condition of affairs not improbable when we reflect that the family was originated on this continent.

Technically, perhaps, Teleoceras should not be considered as generically distinguishable from Rhinoceros, and had it been found in Europe it would doubtless have been referred to that genus. Since however it is an American form, found in the same beds with Aphelops, its unmistakable ancestor, which latter as has been shown by Cope, Scott and Osborn, is quite distinct from Rhinoceros, I have decided to refer it to a distinct genus; believing that classification should rest so far as possible upon our knowledge of actual relations, and should

be an expression of those relations so far as they are understood and not a mere set of conveniences, based entirely upon the presence or absence, and similarity or dissimilarity of parts.

GEOLOGY OF THE REGION.

In the immediate region in which the collections were made, only two distinct geological horizons appear on the surface, these are the Loup Fork and Equus beds. None of the water courses have here succeeded in entirely removing the Loup Fork, and exposing the underlying older strata. The Loup Fork beds consists of light colored, calcareous sandstones, somewhat loosely cemented, resembling in color and friability, old mortar. They are everywhere penetrated by numerous calcareous rods or tubes, probably the casts of root-stocks of aquatic plants. They dip very gently to the southeast which is evidenced by the fact that the southern slopes are gentle, while those looking northward are abrupt. Where they have not been entirely removed by erosion, the Equus beds unconformably overlie the Loup Fork beds. This unconformity has been overlooked by all previous explorations in this region. Marsh makes no mention of it in reporting on his expedition into this very place in 1872; and in his subsequent descriptions of vertebrate fossils from these beds, he has not distinguished between them, although their respective faunas are really quite distinct, and the beds themselves are not the result of a continuous sedimentation from the commencement of the one to the close of the other; but there was an important break at the close of the Loup Fork when this region became dry land, and remained such through a long period of time, after which the Equus beds were deposited upon the eroded surface of the Loup Fork.

The Equus beds are composed of loose, incoherent sands, except for occasional layers of somewhat tough, gritty clays. The rapidity with which they yield to erosion, and their generally incoherent nature has greatly aided in concealing their exact statigraphic relations to the underlying beds. In

almost all exposures the exact contact is concealed by a *talus* from the upper beds. In several instances, however, the true relations were easily determined and one, which presented particularly favorable conditions is represented here in fig. 2. It represents a short section of the east side of one of the main 'draws' emptying into the Niobrara river. At this point this small water course has cut directly across the bed of a similar water course eroded out of the surface of the Loup Fork and since filled by the Equus beds. At this same point there enters the main 'draw' a small tributary from the east, and the combined currents of these two water courses, although

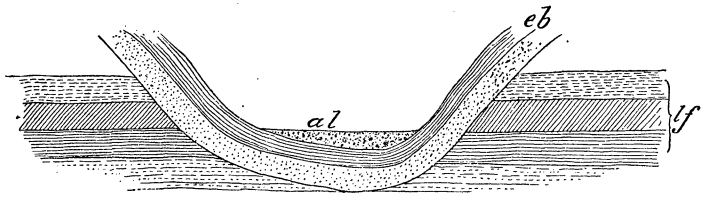


FIG. 2.

entirely dry except immediately after heavy rains, have sufficed to keep the actual contact apparent. At lf. appear the nearly horizontal Loup Fork strata with their characteristic fossils, *Aphelops, Aelurodon, Procamelus, Protohippus, Mastodon*, etc. At eb. the Equus beds are seen resting unconformably upon the Loup Fork beds at an angle of about 15° and containing fossils characteristic of these beds, *Equus, Elephas, Mylodon, Canis*, etc.; al. represents the recent deposits in the bottom of the "draws," all below the top of this line is imaginary. On the opposite side of the main draw the same conditions are seen at the bottom, but toward the top the contact is not so apparent, since there is on this side no tributary to aid in keeping the exposure free from talus.

The figures in the plates and the text accompanying this paper were executed by Mr. Rudolph Weber. To the various members of the expedition, whose liberality made it possible, the authors best thanks are especially due.

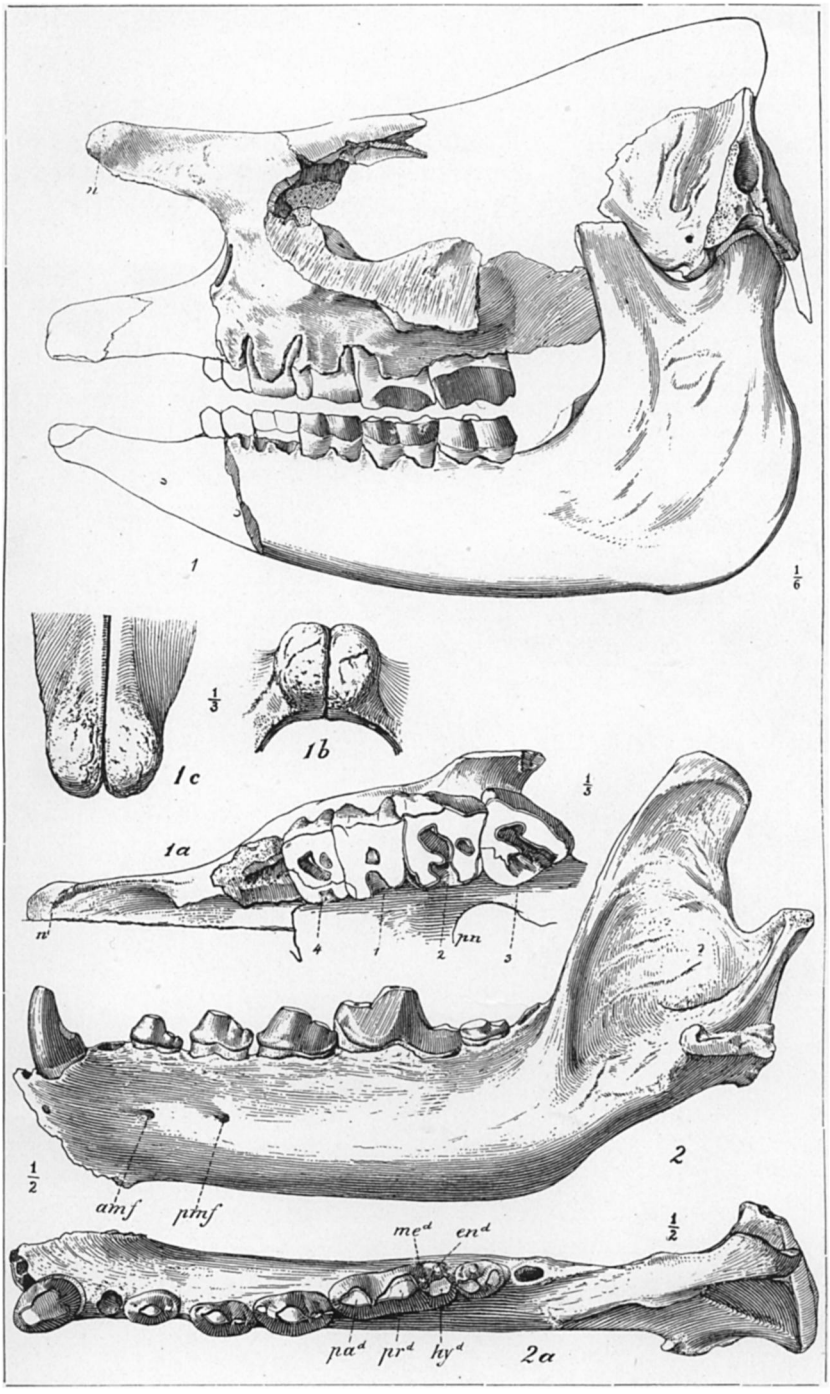
Explanation of Plates.

Plate I.

Fig. 1. Side view of *Teleoceras major*, n. end of nasals.
1ª. Bottom view of *Teleoceras major*, n. end of nasals, pn. posterior nares.
1 . Front view of nasal horn of same.
1ᶜ. Top view of nasal horn of same.
Fig. 2. Side view of lower jaw of *Aelurodon taxoides*, amf. anterior mental foramen, pmf. posterior mental formen.
2ª. Crown view of same; pa^d, paraconid, pr^d. protoconid, hy^d. hypoconid, me^d. metaconid, en^d. entoconid.

Plate II.

Fig. 1. Side view of temporal region of *Rhinoceros sondaicus* (after Flower), mae. meatus auditorius externus, pg. post-glenoid process, pt. post-tympanic process.
Fig. 2. Side view of temporal region of *Teleoceras major*.
Fig. 3. Side view of temporal region of *Aphelops fossiger*.
Fig. 4. Side view of temporal region of *Ceratorhinus sumatrensis*.
Fig. 5. Second, left upper molar of *Aphelops fossiger?* crs. crista, acr. anticrochet, ps. posterior sinus.
Fig. 6. Second, left upper molar of *Teleoceras major*, crs. crista, acr. anticrochet, cr. crochet, ms. median sinus, as. anterior sinus, pf. posterior fossette.
Fig. 7. Second, left upper molar of *Rhinoceras sansaniensis* (after Filhol), ps. posterior sinus, pv. posterior vallum.
Fig. 8. Second, left upper molar of *Aceratherium occidentale?* letters as in fig. 6.
Fig. 9. Second, left upper molar of *Ceratorhinus sumatrensis*, cr. crochet, pv. posterior vallum.



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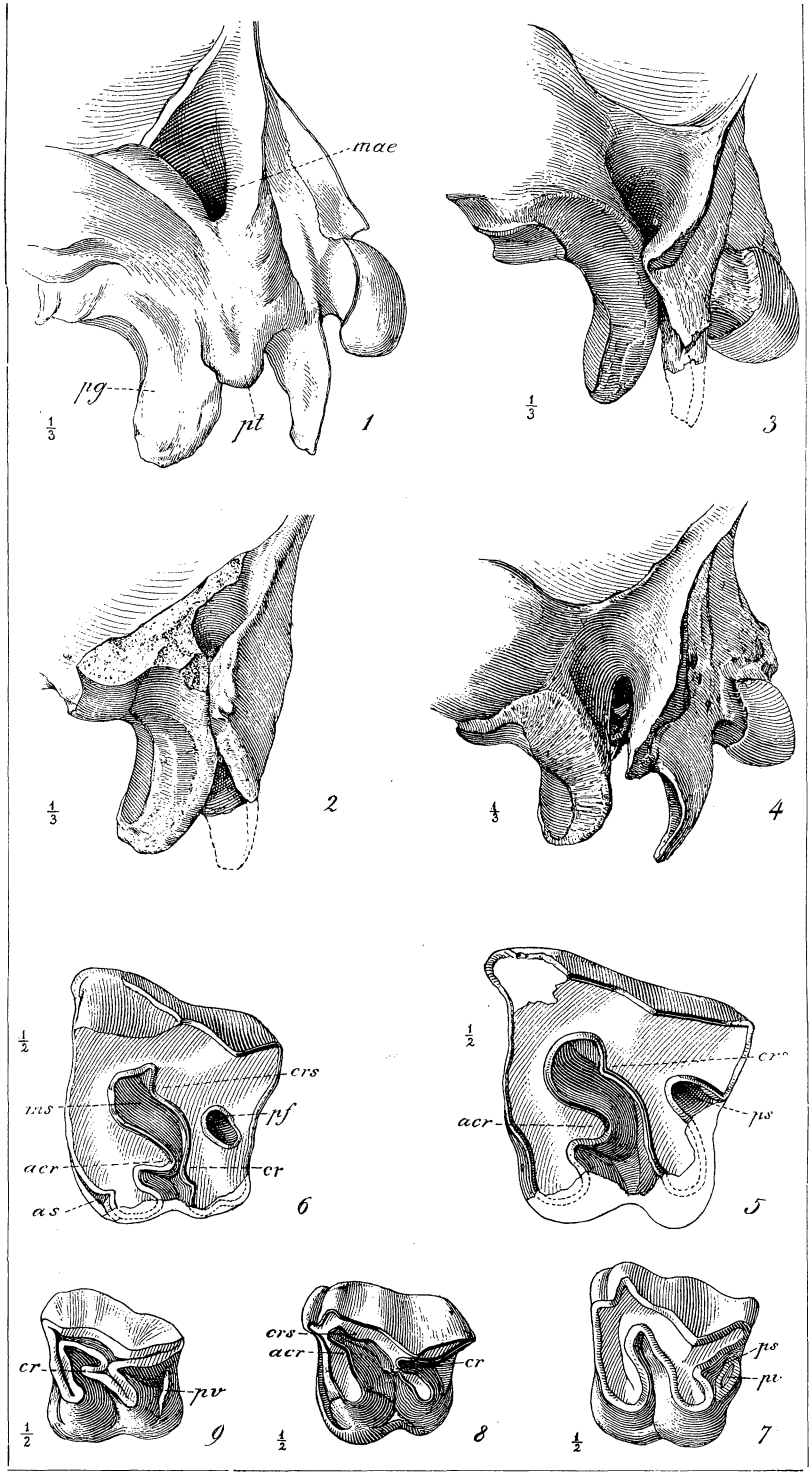
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